FOREST PRODUCTS
Project Fact Sheet

A MOLECULAR ANALYSIS OF CARBOHYDRATE REGULATION IN LOBLOLLY PINE

BENEFITS

- Allows significant gains in the harvest
- Boosts the economy of the southern forest products industry
- Permits better predictions of wood production
- Eliminates need for field trials as a requirement for tree-improvement programs
- Provides a basis for the future manipulation of genetic traits and for obtaining biosynthetic products from plants
- Contributes fundamental knowledge about the DNA structure of loblolly pine
- Leverages funds by using several well-established plantation sites developed by the forest industry as study sites

APPLICATIONS

Commercial tree plantations will be able to use the information gained to increase the capacity for biomass in their breeding programs for loblolly pine.

Molecular Mapping of Loblolly Pine Will Identify Trees of Superior Wood Production

A greater understanding of the physiological and molecular basis of wood production will allow plant breeders to use genetic techniques to select loblolly pine with good growth potential in place of long-term screening of trees, and field trials. The southern forest products industry is dependent upon the availability of the wood fiber of loblolly pine as a fundamental resource. Previous research to increase the wood yield has focused on selecting and breeding trees with specific traits without information on the different genotypes. In recent decades, plant breeders have increased crop productivity dramatically by selecting genotypes associated with improved carbohydrate utilization. This project will apply the same principles toward increasing fiber or wood yield in trees, and it is expected that a set of genetic markers will be identified that correlates with high levels of carbohydrate production and utilization in the trees that bear them.

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PROJECT DESCRIPTION

Goal: To gain improved understanding of the physiological controls and genetic determinates of carbohydrate growth processes in commercial plantations of loblolly pines.

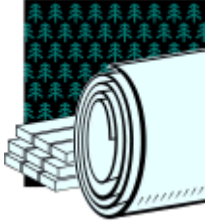
In particular, this three-year project will provide a basis for evaluating whether enhanced carbohydrate production in foliage has an effect on how genes control the use of carbohydrates by loblolly pines. Researchers will also apply the innovative technique, Amplified Fragment Length Polymorphisms (AFLP), for rapid genetic analysis of the loblolly pine at the molecular level, and to determine sequence differences among genotypes.

Mid-rotation trees (those reaching maturity) will be used for the study because at this stage they give a good measure of their final yield of pulpwood. The trees are located at two study sites: Duke Forest, Orange County, NC, which has a facility with a carbon-enhanced atmosphere, and the Southeastern Tree Research and Education Site in Scotland County, NC, with optimal soil nutrients. With optimal nutrients, differences in wood production should be related to the genetic potential of the plant material.

Research on the tree stand at Duke University's CO2 Enrichment Facility (the Duke Forest site) will determine if increased carbohydrate production (because of elevated levels of carbon dioxide) enhances carbohydrate storage and utilization, and therefore, wood growth. This issue is relevant because higher levels of atmospheric CO2 from human activities (e.g., burning of fossil fuels) are expected to continue indefinitely, and it was observed that a long-term increase in the carbon supply may stimulate a feedback mechanism that inhibits plant photosynthesis.

PROGRESS & MILESTONES

- In the first year of the effort, a survey will be made of the relationship between latewood metabolic activity and carbohydrate storage, and the increment in stem growth of trees.
- In year two, powerful molecular techniques will be used to identify DNA polymorphisms (genetic traits) associated with the characteristics sought in tree growth and fiber production.
- Physiological measurements will be made on 15 dominant trees at both study sites, and photosynthetic enzyme content and summertime carbohydrate status will be studied on about 50 individual trees at each site.
- The final year will be spent identifying genetic relationships between individuals at the two sites, using the AFLP markers, and identifying AFLP markers associated with measured physiological traits.



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